# Researchers create and control spin waves, lifting prospects for enhanced info processing

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A team of New York University and University of Barcelona physicists has developed a method to control the movements occurring within magnetic materials, which are used to store and carry information. The breakthrough could simultaneously bolster information processing while reducing the energy necessary to do so.

Their method, reported in the most recent issue of the journal *Nature Nanotechnology*, manipulates "spin waves," which are waves that move in magnetic materials. Physically, these spin waves are much like water waves—like those that propagate on the surface of an ocean. However, like electromagnetic waves (i.e., light and radio waves), spin waves can efficiently transfer energy and information from place to place.

The challenge, scientists have found, is developing a means to create and control them.

In the *Nature Nanotechnology* study, the NYU-UB researchers demonstrated how this could be achieved.

"Spin waves have great potential to improve information processing and make it more energy efficient," says Andrew Kent, a professor in NYU's Department of Physics and the paper's senior author. "Our results show that it's possible to both create and store spin wave energy in remarkably small spaces. The next steps are to understand how far these waves can propagate and how best to encode information in them."

The study's other authors included Ferran Macià, a former NYU-UB Marie-Curie Fellow and now at the University of Barcelona, and Dirk Backes, a former NYU postdoctoral fellow and presently at the University of Cambridge.

Currently, electromagnetic waves in antennas can be converted into spin waves. However, the resulting spin waves have a long wavelength and propagate slowly. By contrast, short-wavelength spin waves can move over greater distances, more quickly, and with less energy, and thus present the possibility of improving a range of communications and electronic devices.

In the *Nature Nanotechnology* study, the researchers conducted a series of experiments in which they built nanometer scale electrical contacts to inject spin-polarized electrical currents into magnetic materials—a process developed to create and control the movements of its spin waves.

Specifically, by blending different magnetic forces they were able to trap them in a specific area—forming magnetic "droplets" that remained in place rather than propagating, thereby forming a stable energy source. Future research, the scientists say, would then focus on ways to move this localized energy or release it in the form of propagating spin waves.

"We've known that spin waves can propagate, but we've shown in this study that you can control them so they will localize in a specific spot," explains Kent. "By changing the mix of magnetic forces on these droplets—such as with a electrical current or magnetic field—we should be able to get them to emit spin-waves, perhaps as energy bursts, that can encode information."

**More information:** Stable magnetic droplet solitons in spin-transfer nanocontacts, *Nature Nanotechnology*, DOI: 10.1038/nnano.2014.255

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